Model MILA-5000-UHV Infrared Lamp Heating System

Instruction Manual

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Preface

Before operating this system, carefully read this manual so that the system can be used correctly.

Limited Warranty

The warranty period for MILA-5000 is twelve (12) months from the date of acceptance.

If any trouble imputable to defects in material or workmanship occurs within the warranty period, ULVAC-RIKO will correct it at no charge either by repair or replacement of defective parts.

Troubles caused by the following are not covered by this warranty.

(1)   Operation not described throughout this manual
(2)   Operation under special conditions not described throughout this manual.
(3)   Repair or modification by other than ULVAC-RIKO

The scope of this warranty is limited to repair of this system or supply of replacement parts.

Secondary or consequential damage caused by failure of MILA-5000 is not covered by this warranty.

Before Operation

Keep this manual at hand for immediate reference.

Carefully read this manual and cautions given throughout this manual and install, operate, inspect and maintain the system correctly according to safety information, cautions, operating procedure, and others.

Always comply with the operating range described throughout this manual, and conduct inspection and maintenance correctly to prevent troubles.

ULVAC-RIKO is not liable for any trouble that may be caused by operation not described throughout this manual, use of replacement parts other than genuine parts or modification of the equipment.

If you come up with any question or problem in operating the system, contact your local ULVAC-RIKO representative or ULVAC-RIKO, Inc., Japan, with the following information.

Model name and serial No. of your system, detailed description of the trouble symptom, condition before and after the trouble occurred, and others.

No part of this manual may be copied or duplicated without consent by ULVAC-RIKO, Inc. in writing.

The contents of this manual are subject to change without notice for improvement in future.

Safety Precautions

Incorrect use of this system may cause fire or electric shock.

Carefully read this manual before installation, operation, inspection and maintenance and use the system correctly.

Before operation, make yourself familiar with components, safety information and safety precautions.

Warnings and cautions contain important information about latent dangers.

WARNING	:	Failure to comply with WARNING involves a possibility of loss of life or serious personal injury.
CAUTION	:	Failure to comply with CAUTION involves a possibility of serious personal injury or physical damage.
Serious personal injury	:	Failure to comply with this notation involves a possibility of loss of sight, injury, burn, electric shock, or fracture, which is accompanied by sequela, or which requires hospitalization for treatment or medical treatment for a long time.
Minor injury	:	Failure to comply with this notation involves a possibility of injury, burn, electric shock or other, which does not require hospitalization for treatment or medical treatment for a long time. It means physical damage, damage to properties and damage to equipment.

CAUTIONS
Read the instruction manual before starting operation.

WARNING: High temperature !
There is a risk of burn. Do not touch it.
Do not bring your hand or face to the exhaust port or gas outlet port

CAUTION: Connect the earth wire.
Otherwise, you may receive electric shock.
Always ground the system.
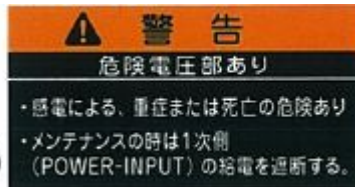

WARNING: Hazardous voltage.
There is a risk of serious bodily injury or
death due to electric shock.
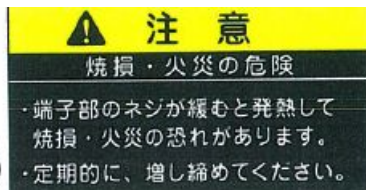Keep the panel and safety cover closed.
Turn off the hazardous voltage power supply
Before maintenance.

CAUTION: Hot heating part present.
There is a risk of burn injury.
Do not touch.

Please cut power off when you maintain the device.

Please do the setting to the device power supply terminal part neatly.
It becomes a cause of the accident.

1. **Safety System**

① Interlock against cooling water failure (option)

The furnace power is turned off if cooling water supply stops.

(only when the optional flow switch is provided. Normally, shorted before shipment from the factory.)
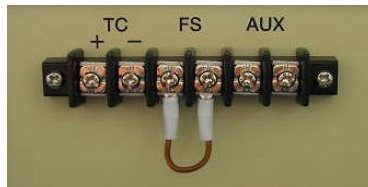
② Overheating prevention (housed in temperature controller)

Overheating temperature is set with the temperature controller. If the set value is exceeded, the interlock will be actuated to turn off the power to the furnace.

③ Control thermocouple burnout (housed in temperature controller)

The interlock will be actuated if the thermocouple has burnt out or the sample outlet port is open, and the power to the furnace is turned off. Heating is disabled.

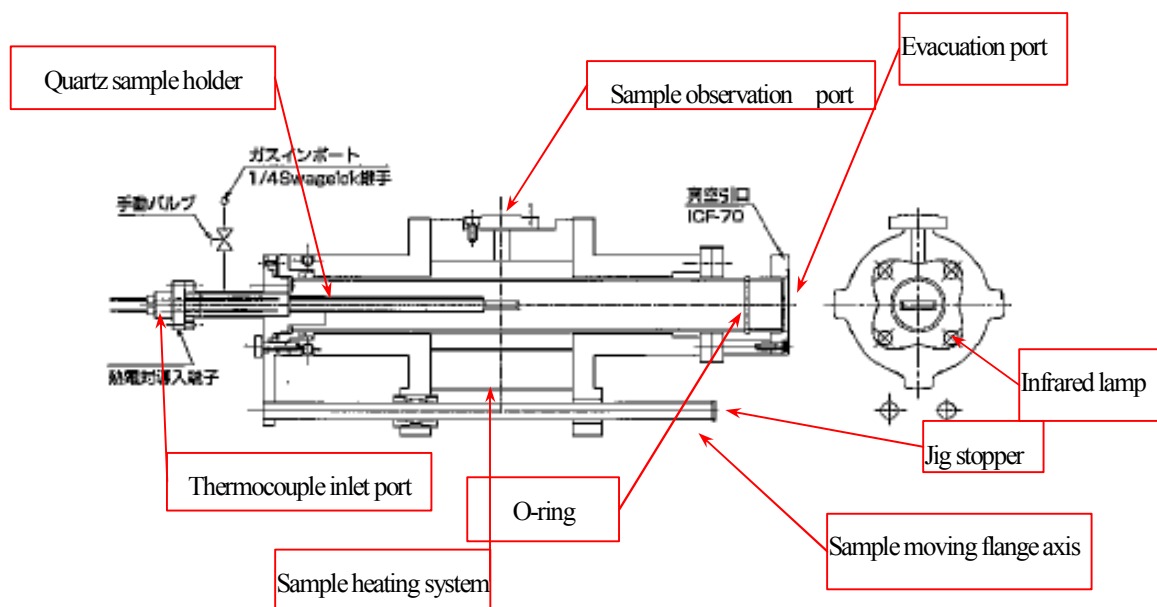The error message "S. Err" appears on the actual temperature indicator.

2. MILA Infrared Lamp Heating Furnace

The heating furnace uses a heating system, in which an infrared (far-infrared) lamp is fixed at the focus of the paraboloidal reflector and reflects infrared beams in parallel. The lamp is available in two types: a near infrared lamp (100 V, 1 kW/piece) with high energy density that can heat the sample to a high temperature efficiently within a short time or a far-infrared lamp (100 V, 250 W/piece) suited to uniform heating. Being sealed in a quartz glass tube, these infrared lamps generates no gas from the heating element and allows clean heating. The furnace body is made of aluminum and is cooled with water to allow heating to a high temperature.

- MILA heating sample assembly

  As shown in Fig. 1, the sample assembly is sealed airtightly with O-rings on both ends of the transparent quartz glass tube and is fixed to the water-cooled aluminum alloy flange. The sample, set on the transparent quartz glass holder, is accommodated in the transparent quartz glass tube and is heated with the infrared lamp (near-infrared, far-infrared) outside of the transparent quartz glass tube.

  When the near-infrared lamp is used, the energy in the wavelength region (0.9 μm or more) irradiated with the near-infrared lamp transmits the transparent quartz glass tube by 95% or more and heats only the sample by radiation, making it suited to high temperature, short time processes.

Quartz sample holder

Sample observation port

Evacuation port

ガスインポート
1/4Swagelok継手

手動バルブ

真空引口
ICF-70

熱電対導入端子

Infrared lamp

Thermocouple inlet port

O-ring

Jig stopper

Sample heating system

Sample moving flange axis

3.　Evacuation System (option)

Ultimate pressure	10 to 4 Pa (room temperature no-load pump head)
Air-cooled oil diffusion pump	50 L/sec
Oil rotary pump	20 L/min
Power requirements	100 V, single phase, 0.35 kW
Weight	Approx. 16 kg
Outside dimensions	346 mm wide by 316 mm deep by 350 mm high

4.　Heated Sample Observation System (option)

Components: CCD camera, macro lens, XYZ adjustment stage
Observation port
CCD camera effective pixel/390,000 pixels
Magnification on the monitor/maximum 150x (on 17" monitor)
17" color monitor

5.　Gas Flow Unit (option)

Float type flow meter (fixed to the side of the basic unit with metal fixture)
　* The gas specie and gas flow rate are to be specified before fabrication
　　(Up to maximum 3 units can be added.)

6.　Cooling Water Circulation Unit (option)

Cooling capacity	1700/1900 kCal/hr
Power requirements	200 V, three phase, 50/60 Hz
Power capacity	3.5 kVA
Weight	Approx. 85 kg
Outside dimensions	550 mm wide by 450 mm deep by 950 mm high

7.　Cooling Water Flow Switch (option)

Installed at the furnace cooling water outlet port.
If the cooling water is shut off or its flow rate becomes lower than the setting, the heating furnace is shut down.

8.   Front panel of MILA

Heating sample assembly

OMRON   E5AR

Sample moving flange

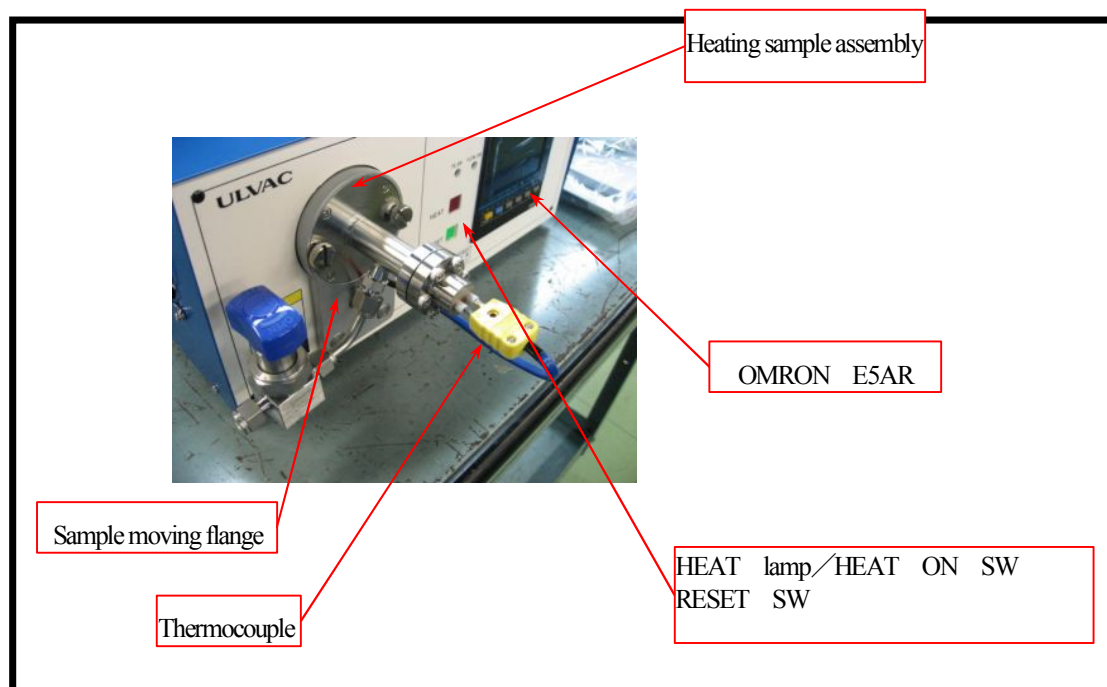HEAT   lamp／HEAT   ON   SW
RESET   SW

Thermocouple

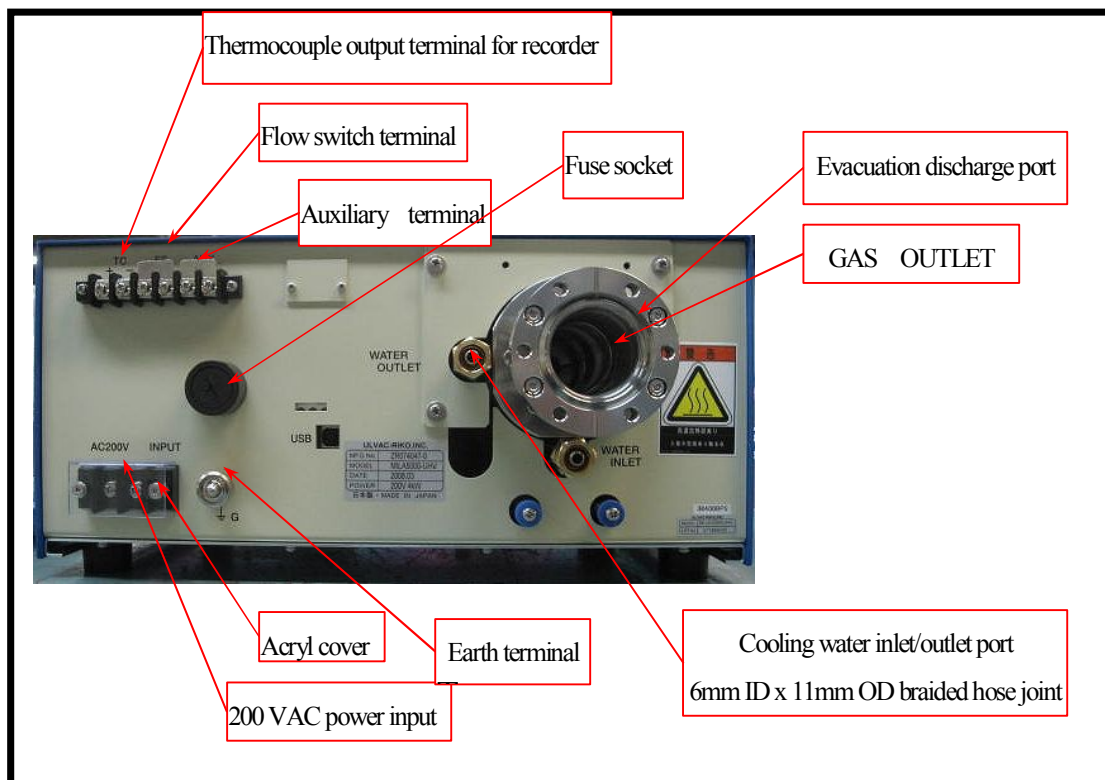Photo 1 MILA front panel

9. Rear Panel of MILA

Photo 2 Rear panel of MILA

9-1   Standard accessories in the rear side of MILA-5000 UHV

(1) ICF-70 Flange　　　　　(2)Bolts with hexagon head screw　　　(3)Gasket

・9-2   Setting way of the flange
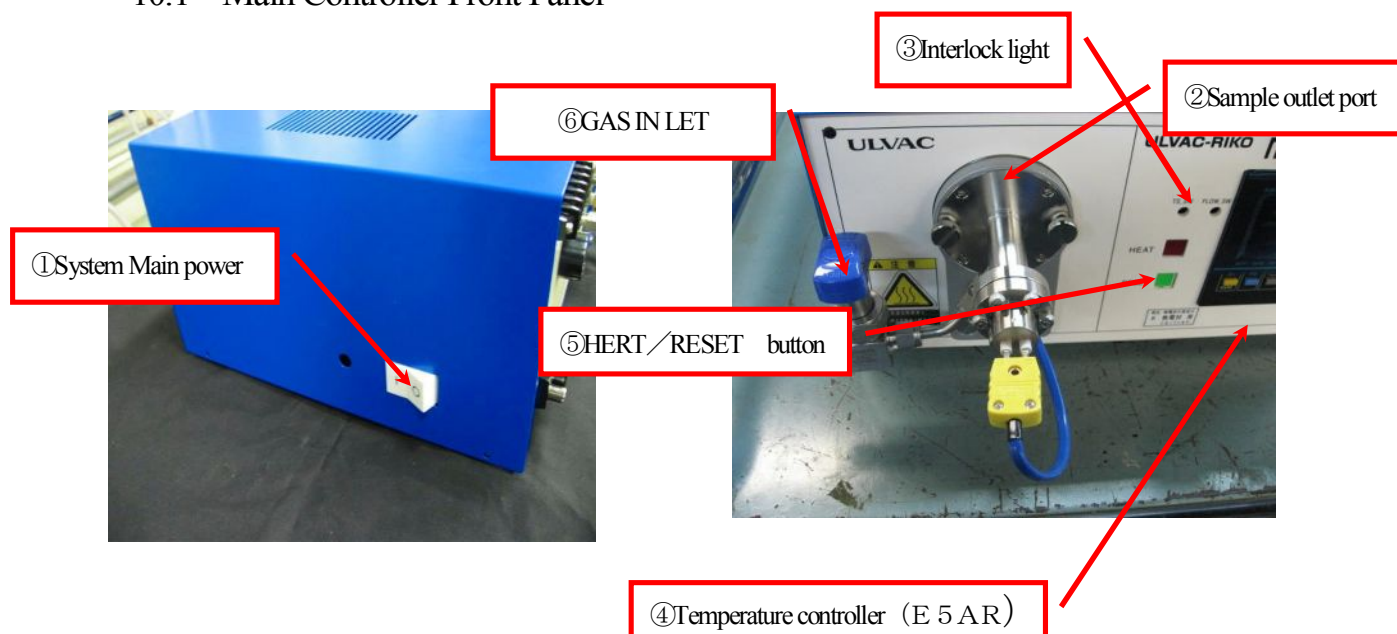

・9-3   setting way of the gasket

*Please tighten in the opposite angle in installing the gasket.
Please tighten so that power is evenly applied to all bolts.
There is a possibility of some leak if you don't.

10. Names and Functions of Components

10.1　Main Controller Front Panel

③Interlock light

②Sample outlet port

⑥GAS IN LET

①System Main power

⑤HERT／RESET　button

④Temperature controller（Ｅ５ＡＲ）

①　Main power

Main power of this system. Turning on the power turns on the power to the temperature controller.

②　Sample outlet port

Open the thumb nut and set the sample holder and light shield.

③　Interlock light
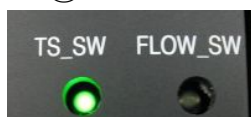
TS_SW light and FLOW_SW light. The light is on when there is no trouble

If either interlock light is off, check the cooling water flow switch or other interlock (both are options). With the standard model (when no option is provided), LOW SW and AUX terminals on the rear of the system are shorted.

Factory setting

{ EMBED Visio.Drawing.5 } FLOW SW

If the optional cooling water flow switch was ordered, connect the cooling water flow switch cable here.

AUX

If any other interlock is added as option, connect it to this switch.

④ E5AR temperature controller

Refer to the E5AR-T program type digital temperature controller for how to operate the temperature controller.

⑤ HEAT/RESET button

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HEAT button

Pressing the HEAT light turns the light red if the interlock is normal. Heating can be started with RUN on the temperature controller when the HEAT light is on. If the light does no come on when pressed, check the interlock (cooling water, AUX).

If the HEAT light does not come on

① Cooling water interlock faulty (FLOW switch terminal block on the rear of the system)

Check cooling water.

If the optional flow switch was not ordered, it has been shorted with a short pin.

② Other interlock faulty (AUX terminal block on the rear of the system)

Check if interlocks are normal.

If optional interlocks have not been ordered, it has been shorted with a short pin.

③ Overheating fault, thermocouple burnout

If SUB2 is lit in excess of the overheating set value on the temperature controller, the HEAT light goes off. Check the overheating set value. Also check if the thermocouple is intact.

Check if the sample outlet port is open.

RESET button

* In case of emergency (to stop heating), heating can be stopped by pressing the RESET button. (The program does not stop.)

10.2 Rear Panel of Temperature Controller

③ Terminal block

① 200V AC input

② Earth

④ USB communication port
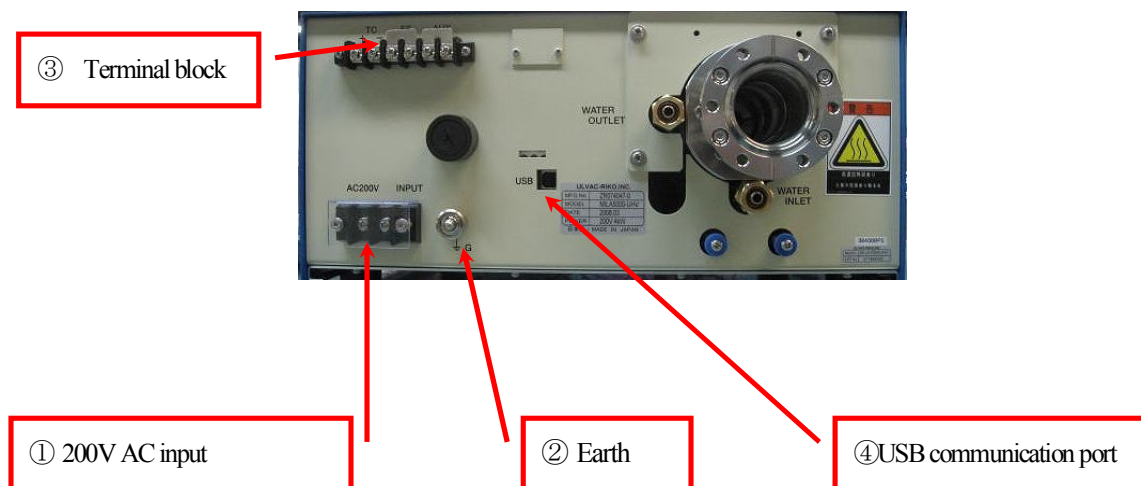
① Power input

Connect your power board (200 VAC, single phase, 20 A or more) to the MILA5000 AC200V INPUT terminal block.

* In connection, retighten the terminal. If the terminal screw is not tightened firmly, it will be overheated, causing fire. So be careful.

② Earth

Connect the earth wire as shown in the photo.

③ Terminal blocks

{ EMBED Visio.Drawing.5 }

1. TC (+)

It is not necessary to connect a thermocouple. (Connect it when it is

desired to acquire the thermocouple output to a recorder or other.)

2. TC (-)

   It is not necessary to connect a thermocouple. (Connect it when it is desired to acquire the thermocouple output to a recorder or other.)

3. F S (Flow Switch)

   Connect the cooling water flow switch cable. (option)

   If the flow switch was not ordered, it has been shorted before shipment from the factory.

4. AUX

   Connect the cable for other interlock (only when the optional interlock was added). Shorted before shipment from the factory.

④ USB port

Used when setting the temperature program or thermocouple from the personal computer.

* For the communication with the personal computer, refer to the operation manual for the MILA control software CX-THERMO.

11. Setting the Sample Holder

{ EMBED Visio.Drawing.5 }
Photo Sample moving flange

① Pass the heat shield through the sample holder.
Set the heat shield between the heat shield stopper of the sample holder and
the
* Never touch the quartz sample holder with bare hands. If the quartz glass
is heated with water or oil on it, it will be devitrified.
If it is stained with water or oil content, wipe it off clean with alcohol.

{ EMBED Visio.Drawing.5 }
Photo Thermocouple set in position

② Pass the thermocouple fixed to the sample moving flange through the sample holder and pull the platinum ribbon on the end of the thermocouple onto the sample stage.

③ Fix the sample holder with the sample holder fixture so that the stage is set in a horizontal position.

* Do not tighten the sample holder metal fixture excessively. The quartz glass sample holder may be damaged. Just tightening the setscrew until the setscrew does not move will do.

* Damage caused by excessive tightening is not covered by warranty.

Specifications of E5AR-T Temperature Controller

- ■ Input unit
  - • High speed sampling
  - • High accuracy/high resolution

    Sampling period : 50 ms

    Accuracy : Thermocouple $\pm$ 1 digit or less ($\pm$ 0.1% PV or $\pm$ 1°C, whichever greater)

    Platinum thermoresistance $\pm$ 1 digit or less ($\pm$ 0.1% PV or $\pm$ 0.5°C, whichever is greater)

    Analog ($\pm$ 0.1% full scale) $\pm$ 1 digit or less

    (Refer to Appendix: Specifications for exceptions.)

    Input resolution : 1/100°C

    (Pt100: 0.01°C resolution from - 150.00 to 150.00°C)

    High speed sampling and high accuracy/high resolution have been realized simultaneously, allowing control with high accuracy high speed response according to application.
  - • Multi-input

    An abundant input range from temperature input to analog input is available.

    Temperature input : Thermocouple K, J, T, E, L, U, N, R, S, B, W
    Platinum thermoresistance Pt100

    Analog input : Current input 4 to 20 mA, 0 to 20 mA
    Voltage input 1 to 5 V, 0 to 5 V, 0 to 10 V
  - • Multi-point input

    Model E5AR-T is available in 2-input type and 4-input type and Model E5ER-T is available in 2-input type.
- ■ Control unit
  - • Program

    Up to maximum 32 programs can be created, in which the target value, time, PID group No., alarm group No., weight width higher/lower limit values, number of program repeat times and program link destination No. are registered.

    The target value, time, wait valid, and segment output can be set for each segment.
  - • PID group

Setting data for PID control (PID values, variable control limit value, and automatic selection range higher limit value) can be created up to maximum 8 groups.

Each PID group directly specifies with the PID group No. in the program, but also can automatically select the PID group that changes over according to the current value, deviation and target value.

- Abundant control modes and control functions

  One unit of the 2-input type or 4-input type permits coordinated operation. The slave type controller that has been necessary is no longer necessary.

  The position proportional type permits selection of floating control and closed control. In floating control, position proportional control can be made without using a potentiometer.

■ Output unit

- Multi-output

  Multi-output compatible with current output and voltage output (pulse) is available.

- High resolution

  Resolution of current output

  0 to 20 mA   : Approx. 54,000 resolution

  4 to 20 mA   : Approx. 43,000 resolution

- Table of Inputs

Set value	Input type	Set range	
		(°C)	(°F)
1	Pt100 (1)	-200.0 to 850.0	-300.0 to 1500.0
2	Pt100 (2)	-150.00 to 150.00	-199.99 to 300.00
3	K (2)	-20.0 to 500.0	0.0 to 900.0
4	J (1)	-100.0 to 850.0	-100.0 to 1500.0
5	J (2)	-20.0 to 400.0	0.0 to 750.0
6	T	-200.0 to 400.0	-300.0 to 700.0
7	E	0.0 to 600.0	0.0 to 1100.0
8	L	-100.0 to 850.0	-100.0 to 1500.0
9	U	-200.0 to 400.0	-300.0 to 700.0
10	N	-200.0 to 1300.0	-300.0 to 2300.0
11	R	0.0 to 1700.0	0.0 to 3000.0
12	S	0.0 to 1700.0	0.0 to 3000.0
13	B	100.0 to 1800.0	300.0 to 3200.0
14	W	0.0 to 2300.0	0.0 to 4100.0
15	4 to 20 mA	One of the following ranges is displayed according to scaling.	
16	0 to 20 mA	-19999 to 99999	
17	1 to 5 V	-1999.9 to 9999.9	
18	0 to 5 V	-199.99 to 999.99	
19	0 to 10 V	-19.999 to 99.999	
		-1.9999 to 9.9999	

[Miscellaneous]

Communicating function

> The temperature program and other important data can be transferred from the personal computer to the temperature program via USB cable and monitored during operation by using the supplied software CX-thremo. Refer to the CX-thermo manual for the software specifications.

Names of components of temperature controller E5AR

■ Names of components on front panel

- Model E5AR-T

{ EMBED Visio.Drawing.5 }

Initial window

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Components on initial window

① Indicating light

SUB1: SUB1 lights when heating is started normally.

SUB2: SUB2 lights if the overheating interlock is actuated. If heating test is being made, SUB1 goes off simultaneously with SUB2 coming on.

② 1st display

Displays the actual thermocouple temperature.

③ 2nd display

Displays the programmed temperature.

④ 3rd display

Displays the program pattern No. and step.

How to input the temperature program

The following program is set.

{ EMBED Visio.Drawing.5 }

* The method of inputting the program above is described below as an example.

Temperature program inputting procedure

(1) Specify a PTN No. to use using the PF2 key. PTN1 is specified in the photo below.

(2) Create a temperature program.

{ EMBED PBrush } 1. Press the Level key in the initial window to transfer control from "Operation Level" to "Program Setting Level". Specify program No. "1" with "prgm: Edit program".

Up to maximum 32 programs can be created.

A total of 256 steps can be registered.

(Maximum 16 programs can be created (No. 1

to No. 16) and maximum 16 steps can be input.)

To change the maximum input number of programs, use the supplied software CX-thermo.

{ EMBED Visio.Drawing.5 }

2. Press the Mode key for less than a second and select "s-no: number of segments". Press the Up key and set an arbitrary number of segments. The number of segments is "6" in the case of the segment above.

"Segment" is the total number of steps of the temperature program.

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{ EMBED Visio.Drawing.5 }

3. Press the Model key, select "seg.n: Edit segment" and press the UP key to select "1" from "end".

{ EMBED PBrush }

4. Press the Mode key and select "sp:Segment target value". Press the Up key to set the target value at "200.0".

(Set the actual ultimate target temperature.)

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5. Press the Mode key twice and select "time: Segment time". Press the Up key to set time at "1.00".

(Input the actual target elapse time of each step.)

Press the Mode key to display the Pr window, but it is not necessary to input. Input will be invalidated. The input value is 0.

Pr window

In heating with this temperature controller, time or gradient is set. If gradient is set, the Pr value will be validated.

Time has been set before shipment from the factory, so that it is not necessary to input it in the Pr window.

{   EMBED Visio.Drawing.5   }

6. Press the Mode key and select "wait: Wait effective".   is turned "off".

{   EMBED Visio.Drawing.5   }

7. Press the Mode key 3 times to return control to "segn: Edit segment" The segment No. automatically becomes "2"

(Repeat this step up to the last segment. Up to segment 6 with the above program.

8. Press the Mode key and select "sp: Segment target value". Press the UP key to set the target value at "800.0".

9. Press the Mode key twice and select "time: Segment time". Press the Up key to set time at "1.30".

10. Press the Mode key and select "wait: wait effective". Turn it "off",

11. Press the Mode key three times to revert to "segn: Edit segment". The segment No. is automatically set at "3".

When input of temperature and time is completed to the last segment, the window displays [END], thereby temperature program input being completed.

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* Refer to the OMRON E5AR-T User's Manual for more information about the method of inputting the temperature program.

How to input (register) PID values (when manually inputting a value)

PID values can be registered up to a total of 8 patterns.

How to register

{ EMBED PBrush }
1. Press the Level key 4 times in the initial window.
2. Specify a PID No to use with the UP/DOWN key.
3. Press the Mode key once.

{ EMBED PBrush }
4. Input PID values.

{ EMBED Visio.Drawing.5 } 5. Input I value.

{ EMBED Visio.Drawing.5 } 6.　 Input D value.

To make heating test
　① 　Press the PF2 key to select a program pattern to use.
　② 　Holding down the PF1 key starts heating. To stop heating, hold down the PF1 key again.
　　Specify PID values and alarm to use during heating test.

{ EMBED　Visio.Drawing.5 　Input a PID No. to use.
} 　　　　　　　　　　　 Input a PID No. to use, 0 to 8.
　　　　　　　　　　　　In the photo at left, PID No. 1 is specified.
　　　　　　　　　　　　(PID has a total of 8 patterns.)

{ EMBED　Visio.Drawing.5 　Input an alarm to use No. 1 to 4.
} 　　　　　　　　　　　 Up to 4 alarm Nos. can be registered in total.
　　　　　　　　　　　　In the photo at left, alarm No. 1 is specified.
　　　　　　　　　　　　(Example) Alarm 1 = 1200°C
　　　　　　　　　　　　　　　　　　Alarm 2 = 1000°C
　　　　　　　　　　　　　　　　　　Alarm 3 = 800°C
　　　　　　　　　　　　　　　　　　Alarm 4 = 500°C
　　　　　　　　　　　　If the alarm setting is registered as shown above and alarm No. 1 is specified, heating to 1200°C has been set.
　　　　　　　　　　　　Refer to the alarm temperature setting method.

Using PID pattern
　• When running a heating/holding program with one PID
　① 　Press the Level key in the initial window.
　② 　Press the Mode key 3 times.
　③ 　Specify a PID pattern No. to use. Up to a total of 8 patterns of PID can be registered.
　　＊ Holding down the PF1 (RUN) key starts heating test using the specified PID

Basically, once PID values are calculated by auto tuning, temperature can be increased/held with one PID   , except special temperature recipe.

Procedure

(1)   Set sample.
(2)   Start heating.
(3)   Heating → holding   Auto tuning during holding
(4)   PID values being used are automatically calculated.

Auto tuning (AT)

{ EMBED Visio.Drawing.5 }   Press the Level key twice.

Change display ② from "OFF" to "0" or "1 to 8" with the up/down key to start AT.

If AT is started by specifying "0", the display ① blinks and the PID group No. now being used appears at display ②. With completion of AT, the display ① stops blinking.

If "1 – 8" is specified, the PID value of the specified PID group No. is changed.

For more information about the method of AT operation, refer to the OMRON E5AR-T User's Manual.

■ AT (Auto Tuning)

• AT automatically sets optimum PID constants for the target value when executing. This system employs the limit cycle method, which finds the characteristics of an object to control by changing the control variable.

① Set program   ② Program executed   ③ AT start
        ④ AT end   ⑤ Time

• During AT, segment operation, such as change of set data, hold/hold resetting, advance, back, etc., cannot be performed.

• AT will be stopped if "Run/Reset" is "Reset" (when "action at resetting" is "control stop") or is set in the manual mode. AT cannot be executed during resetting (when the "action at reset" is "control stop") or in the manual mode,

• When executing AT, specify "0" or when executing AT by specifying the PID group No., specify "1 to 8".

• The result of AT is reflected in "Proportional band", "Integral time" and "Differential time" of the PID group No. specified at AT of "PID set level". When "Action at reset" is "Constant value control", the action is as follows.

• If "Run/Reset" is set at "Reset" during AT execution during run, the current target value is changed over to a constant value SP after AT has ended.

- If AT is executed during resetting and "Run/Reset" is set at "Run" during AT execution, the set program will start after AT has ended for the set value SP.
- Description of AT Actions

{ EMBED PBrush
    }
   ↓

{ EMBED PBrush   Changing "AT execution/stop" from OFF to 0 starts AT.
    }
   ↓

{ EMBED PBrush   During execution, the 1st display of "Execute AT/Stop"
    }   blinks and the 2nd display shows the PID group No. currently being used for control. With completion of AT, "Execute AT/Stop" is turned off and the display stops blinking.

AT is executed and the following display appears

1st display: Blinking display that shows that AT is being executed.

2nd display: The display changes over to the selected PID group No.

    ↓

{ EMBED PBrush   To stop AT, specify "off : Stop AT".
    }

{ EMBED PBrush   If control is shifted to operation level during AT execution
    }   and "Current value/Target value" is set, the 2nd display blinks, indicating that AT is being executed.

- During execution of AT, "Communication write", "Run/Reset", "AT execution/stop", and "Auto/Manual" can be changed. Other set data cannot be changed.
- If Reset is set with "Run/Reset" during execution of AT, AT is stopped to stop operation if "Action at Reset" is "Control Stop". Even if Run is set with "Run/Reset" again, AT does not restart.

- If any input fault occurs during execution of AT, AT is stopped and is executed again by resetting input error.

How to set overheating (alarm)

{ EMBED Visio.Drawing.5 }

① Press the Level key 3 times in the initial window.
The photo at left shows, pattern No. 1 overheating setting.

{ EMBED PBrush }

② Press the Mode key.

Select the alarm pattern No. with the UP/DOWN key.

(Alarm can be set up to 4 patterns.)

The photo at left shows the overheat setting of alarm setting temperature No. 1

Press the Mode key.

{ EMBED Visio.Drawing.5 }

Input the overheat setting temperature with the UP/DOWN key.

* On the photo at left, the overheat setting temperature is 0°C.

SUB2 lights because the overheat setting value is below room temperature (below PV value). The overheat interlock is actuated.

Input a temperature arbitrarily.

If the overheat setting temperature is exceeded during heating test, heating will be stopped and the lamp is turned off. Simultaneously with heating being stopped, SUB1 goes off and SUB2 comes on. Heating cannot be made if the actual temperature is in excess of the overheat setting value.

Heating is ready when the creation of the temperature program, registration and specification of PID, and setting and specifying of overheating are completed. Heating can be started by holding down the PF1 key for a while.

* For emergency stop and heating stop, hold down the PF1 key or press the RESET button.

* If the set values are lost (unknown) during input (to revert to the initial window), press the Level key several times to revert to the initial window.

Other functions

How to set thermocouple

Hold down the Level key. The window is changed over.

{ EMBED Visio.Drawing.5 }
Set the thermocouple with the UP/DOWN key.

Example of setting

① K thermocouple → 2

② R thermocouple → 11

Upon completion of setting, hold down the PF2 key to revert to the initial window.

Refer to the OMRON E5AR-T User's Manual for more information about the thermocouple setting.

Changing over AUTO heating and MANU heating

Press the Mode key 12 times in the initial window.

Change over AUTO or MANU with the up/down key.

The mode is changed over to MANU several seconds after MANU is selected.

AUTO: Heating by a specified temperature program

MANU: Regulate the output with the UP/DOWN key.

If MANU is selected, control the output with the UP/DOWN key. (Output can be set during and before heating.)

To select the AUTO mode again, press the Mode key 12 times in the window shown below and select AUTO with the UP/DOWN key.

The photo shows MANU 100% output.

Setting the unit of program time

{ EMBED Visio.Drawing.5   Hold down the Level key in the initial window.

}   Press the Mode key.

                                     Press the Mode key 7 times in the window at left.

{ EMBED PBrush }   Set "hour, minute", "minute, second" and "minute, second, 100 millisecond" using UP/DOWN key.
In the window at left, "minute, second" are set.

{ EMBED PBrush }   In the window at left, "hour, minute" are set.

{ EMBED PBrush }   In the window at left, "minute, second, millisecond" are set.

                             *   For more information about how to set the unit of program time, refer to the OMRON E5AR-T Users Manual.

■   Manual Setting

For manual setting of PID constants, set values in "Proportional Band", "Integral Time" and "Differential Time".

[Supplement]

- If control characteristics are already known, set PID constants directly. Set PID constants with "Proportional Band", "Integral Time" and "Differential Time".
- Set PID constants I (integral time) and D (differential time) at 0 to make proportional action. The manual reset value has been set at 50% as the initial value, so that the center of the proportional band is the target value.

When P (proportional band) is changed

Increase	Target value	Slow rise and longer settling time, but no overshooting

Decrease	Target value	Overshooting and hunting, but set value is attained sooner to stability.

When I (integral) time is changed

Increase	Target value	Longer time before target value is attained Longer settling time，but smaller hunting, overshoot and undershoot
Decrease	Target value	Overshoot and undershoot occur. Hunting occurs. Shorter rise time.

When differential time (D) is changed

Increase	Target value	Shorter overshoot and undershoot settling time, but minor hunting in its own change.
Decrease	Target value	Higher overshoot and undershoot and more time is required to restore the target value.

- Application
  Changing PID at each step with a multi-step heating/holding program
  Multi-step PID: PID is changed over depending on a specified temperature range.
  * Basically, temperature can be controlled with one PID by using auto tuning. Conduct auto tuning first.

Automatic selection of PID group

PID group	Automatic selection range higher limit value
1	200.0
2	400.0
3	500.0
4	600.0

← PV (current value)

5	700.0
6	800.0
7	1000.0
8	1300.0

← Internal fixed value
: 999.9% FS

In the example above (when "PID group automatic selection data" is "PV"), the following PID values are effective.

When PV≤200.0°C   : PID group No. 1

When 200.0<PV≤400.0°C : PID group No. 2

Set the "PID group automatic selection range higher limit value" in such a way that the set values become higher in increasing order of the PID group Nos.

However, the PID group No. 8 is internally fixed at "automatic selection range higher limit value=999.9%FS"

To prevent chattering when changing over the PID group, hysteresis can be set with "PID group automatic selection hysteresis".

The PID group automatic selection data can be selected from PV, DV (deviation) and SP (current target value).

Set data	Set range	Unit	Initial value
PID group No.	0: Automatic selection 1 to 8: PID group No.1 to 8	-	0
PID group No. 1 – 8 automatic selection range higher limit value	- 19999 to 99999	EU	1450.0
PID group automatic selection data	0: PV, 1: DV, 2: SP	-	0: PV
PID group automatic selection hysteresis	0.10 to 99.99	%FS	0.50

①   Press the Level key 4 times in the initial window.

②   Press the Model key 6 times.

③   Specify PID No. at 0.

{ EMBED Visio.Drawing.5 }   Press the Level key 4 times in the initial window.

The window at left appears.

Specify the PID No.
(Example)

PID group	Automatic selection range higher limit value		
1	200.0		
2	400.0	←	PV (current value)
3	500.0		
4	600.0		
5	700.0		
6	800.0		
7	1000.0		
8	1300.0	←	Internal fixed value : 999.9 FS

{ EMBED PBrush }   Set the temperature range of PID. No.1.
For example, input 200°C in the table.
Input PID. No. 2 to 8 in the same manner as above.

For more information about how to change over PID, refer to the OMRON E5AR Users' Manual.

* Basically, temperature can be controlled with one PID constant. Change PID at each step only in a special case. Calculate PID by auto tuning.

Other functions that are used often

Hold

Initial window in heating →   Press Mode key twice →   Change over to ON with UP/DPWN key.
HOLD light comes on at HOLD.

{ EMBED Visio.Drawing.5 }   { EMBED Visio.Drawing.5 }

→ To terminate HOLD, turn off HOLD with the UP/DOWN key again.

ADVANCE

Initial window in heating →   Press MODE key twice. →   Change over to ON with UP/DOWN key.

{ EMBED Visio.Drawing.5 { EMBED Visio.Drawing.5 }   { EMBED Visio.Drawing.5 } }

→ STEP is changed over to the next step simultaneously with ON.

For more information about the settings of each component, refer to Model E5AR-T Users' Manual for the Program Type Digital Controller